

REMARKS

Claims 1-26, 28-43, 46-53, and 56-58 are currently pending in the application. Claims 1-2, 5-12, 17-20, 25, 28-31, 36-43, 46-53, 56, and 58 have been amended. Claims 27, 44-45, and 54-55 have been canceled. Applicant respectfully submits that no new matter has been added. Applicant respectfully requests reconsideration of the application in view of the foregoing amendments and the following remarks.

Claims 10-16, 51, and 53 have been indicated as allowable. Claims 37 and 45 stand objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form. Claims 8, 29, 39-40, 47-48 and 50 have been indicated as being allowable if rewritten to overcome the rejections under 35 U.S.C. § 112, 2nd paragraph. Applicant thanks the Examiner for the indication of allowable subject matter.

The drawings stand objected to due to some informalities. In response, Applicant has amended Figures 4 and 5 to identify a wellhead with reference numeral 31 and a well with reference numeral 69. In addition, Figures 1-2 have been amended to include a legend identifying the figures as prior art. Withdrawal of the objection to Figures 1-2 and 4-5 is respectfully requested.

Claim 11 stands objected to because the word "hold" should be "hole." In response, Applicant has amended claim 11 to correct the noted error. Claim 19 stands objected to because the acronym "PJARMD" was not previously defined in the claims. In response, Applicant has amended claim 19 to define the acronym "PJARMD." Claim 54 stands objected to because the acronym "HPJD" was not previously defined in the claims. In response, Applicant has canceled claim 54, thus rendering the objection thereof moot. Claims 39-40 and 47-48 stand objected to because the word "reservoir" should be "reservoirs". In response, Applicant has amended claims 39-40 to recite "reservoirs". In addition, claim 46 has been amended to recite a first and second reservoir. Claim 56 stands objected to because the acronym "PJAltMD" should be "PJARMD". In response, Applicant has amended claim 56 to recite "PJARMD." Withdrawal of

the above objections in regard to informalities contained in claims 11, 19, 39-40, 47-48, and 56 is respectfully requested.

Claim 8 stands rejected under 35 U.S.C. § 112, second paragraph, as being indefinite. More specifically, the office action asserts that the phrase "the rate is greater" makes the claim unclear. In addition, the phrase "the continuous production rate" lacks antecedent basis. In response, Applicant has amended claim 8 to clarify that, periodically, an injection rate is greater than the continuous production rate. Applicant has also amended claim 1 to recite "a continuous production rate" to provide necessary antecedent basis for the phrase in claim 8. Withdrawal of the rejection under 35 U.S.C. § 112 is respectfully requested.

Claim 25 stands rejected under 35 U.S.C. § 112. More specifically, the term "the reservoir" lacks antecedent basis. In response, Applicant has amended claim 25 to clarify that "the reservoir" is "the thermal energy reservoir." Withdrawal of the rejection under 35 U.S.C. § 112 is respectfully requested.

Claim 29 stands rejected under 35 U.S.C. § 112 as being indefinite due to some informalities. In response, Applicant has amended claim 29 to depend from claim 20. Withdrawal of the rejection under 35 U.S.C. § 112 is respectfully requested.

Claim 38 stands rejected under 35 U.S.C. § 112. More specifically, the phrases "the injection wells" and "the production rate" lack antecedent basis. In response, Applicant has amended claim 38 to clarify that an injection rate is periodically greater than a production rate. Withdrawal of the rejection under 35 U.S.C. § 112 is respectfully requested.

Claims 39-40 stand rejected under 35 U.S.C. § 112. More specifically, the office action asserts that it is unclear how many reservoirs are being claimed. In response, Applicant has amended claims 39-40 to further include a second reservoir. Withdrawal of the rejection under 35 U.S.C. § 112 is respectfully requested.

Claim 46 stands rejected under 35 U.S.C. § 112. More specifically, the phrases "the injection wells" and "the production rate" lack antecedent basis. In response, Applicant has amended claim 46 to clarify that at least one injection well injects at a rate that periodically exceeds a production rate. Withdrawal of the rejection under 35 U.S.C. § 112 is respectfully requested.

Claims 47-48 stand rejected under 35 U.S.C. § 112. More specifically, claims 47-48 refer to multiple reservoirs but depend from claim 46, which claims a single reservoir. In response, Applicant has amended claim 46, from which claims 47-48 depend, to recite first and second reservoirs. Withdrawal of the rejection under 35 U.S.C. § 112 is respectfully requested.

Claim 50 stands rejected under 35 U.S.C. § 112. More specifically, the phrase "the rate is greater" is asserted in the office action to be unclear. In response, Applicant has amended claim 50 to clarify that, periodically, an injection rate is greater than the continuous production rate. Withdrawal of the rejection under 35 U.S.C. § 112 is respectfully requested.

Claims 1, 4-7, 17 and 52 stand rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,685,362 to Brown ("Brown"). Independent claim 1 relates to a method of extracting thermal energy from a rock formation. Applicant respectfully submits that Brown fails to disclose at least one of the distinguishing features of amended independent claim 1, namely, alternately opening and closing a plurality of discharge control valves and a plurality of injection control valves to provide a continuous production rate from a plurality of wells and permit discharge from at least one joint cloud reservoir.

Brown discloses a method of extracting thermal energy, in a cyclic manner, from geologic strata which may be termed hot dry rock.¹ Brown also discloses that water is continuously withdrawn from a reservoir at two different flow rates, a base rate and a peak rate.² The rate of withdrawal is accomplished through a decrease of backpressure at an outlet of a

¹ Brown, Col. 3, Ln. 44-46.

² Brown, Col. 3, Ln. 53-56.

production well.³ In contrast to independent claim 1, Brown discloses the use of a single backpressure control valve, but fails to disclose the use of a plurality of discharge and injection control valves to provide a continuous production rate from a plurality of wells as claimed. Applicant respectfully requests that the rejection of independent claim 1 under 35 U.S.C. § 102(b) be withdrawn.

Dependent claims 4-7 depend from and further limit independent claim 1 in a patentable sense. Applicant respectfully submits that, for at least the reasons set forth above with respect to the rejection of independent claim 1, dependent claims 4-7 distinguish over Brown and are in condition for allowance. Withdrawal of the rejection of dependent claims 4-7 under 35 U.S.C. § 102(b) is respectfully requested.

Dependent claim 17 has been amended to now depend from independent claim 10. Independent claim 10 has been indicated as allowable. Applicant respectfully submits that dependent claim 17 is now in condition for allowance. Withdrawal of the rejection of dependent claim 17 is respectfully requested.

Independent claim 52 relates to a method of extracting thermal energy from a rock formation. Applicant respectfully submits that Brown fails to disclose at least one of the distinguishing features of independent claim 52, namely, alternately opening and closing at least one set of discharge control valves and at least one set of injection control valves to provide flow to and from at least one of the wells and permit alternate charging and discharging to and from a reservoir. In addition, Applicant respectfully submits that independent claim 52 patently distinguishes over Brown for similar reasons to those discussed above with respect to independent claim 1. Applicant respectfully requests that the rejection of independent claim 52 under 35 U.S.C. § 102(b) be withdrawn.

Independent claim 58 stands rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 3,975,912 to Greene ("Greene"). Independent claim 58 relates to a method of processing chemical reactions utilizing a reactor vessel immersed in a geothermal production

³ Brown, Col. 5, Ln. 29-31.

well. Applicant respectfully submits that Greene fails to disclose at least one distinguishing feature of independent claim 58, namely, that geothermal heat energy is used to initiate, sustain, and or support conditions and or reactions within a reactor vessel in order to conduct chemical reactions at or above 375 °C.

Greene discloses a method and apparatus which utilizes steam from a geothermal aquifer for dual power extraction.⁴ More specifically, Greene discloses a method and apparatus for alternating the flow of steam between two wells so that condensate is not allowed to build up in either well.⁵ Greene also discloses that an energy extractor is placed within each of two wells that are in fluid communication with a geothermal aquifer.⁶ Water passing through the extractor is heated by steam from the geothermal aquifer as it rises up the well and passes by the energy extractor.⁷ The aquifer steam is also carried via pipes to the surface where it gives up more heat in another energy extractor located on the surface.⁸ In this way, Greene discloses that steam from a geothermal aquifer is used to transfer heat into a working fluid at two different times during the power generation cycle.

Applicant respectfully submits that Greene fails to disclose that a chemical reaction is sustained in a reactor vessel at or above 375 °C as claimed. In contrast, Greene discloses that steam is used to heat a fluid within the energy extractor. The heating of a liquid is simply energy transfer, and not a chemical reaction as claimed. Furthermore, Greene does not teach that a temperature of at least 375 °C can be sustained within a reactor vessel as claimed. Because Greene teaches the use of steam from an aquifer for energy transfer, Applicant respectfully submits that Greene does not teach that a chemical reaction can be maintained at 375 °C. Applicant respectfully requests that the rejection of independent claim 58 under 35 U.S.C. § 102(b) be withdrawn.

⁴ Greene, Col. 2, Ln 67-Col. 3, Ln 23.

⁵ Greene, Col. 3, Ln 49-52.

⁶ Greene, Col. 3, Ln. 2-6.

⁷ Greene, Col. 3, Ln. 6-9.

⁸ Greene, Col. 3, Ln. 53-60.

Dependent claims 2-3 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Brown in view of U.S. Patent No. 3,375,886 to Goodwin et al. ("Goodwin"). Applicant respectfully submits that, at least for the reasons set forth above with respect to independent claim 1, dependent claims 2-3 distinguish over Brown. Goodwin relates to a method of treating abrasive-laden liquid discharged from the well in a hydraulic jet drilling.⁹ Goodwin fails to cure the deficiencies of Brown noted above. Withdrawal of the rejection of dependent claims 2-3 under 35 U.S.C. § 102(b) is thus respectfully requested.

Dependent claim 9 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Brown in view of prior art cited in Applicant's specification and in Applicant's Figure 2. Applicant respectfully submits that, at least for the reasons set forth above with respect to independent claim 1, dependent claim 9 distinguishes over Brown. The prior art cited in Applicant's specification fails to cure the deficiencies of Brown, namely, the use of a plurality of discharge control valves and a plurality of injection control valves to provide a continuous production rate from a plurality of wells as claimed in amended independent claim 1. Withdrawal of the rejection of dependent claim 9 is thus respectfully requested.

Dependent claims 18-19 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Brown in view of U.S. Patent No. 3,231,031 to Cleary ("Cleary"). Applicant has amended dependent claim 18 to depend from independent claim 10. Independent claim 10 has been indicated as allowable. Dependent claim 19 depends from claim 18 in a patentable sense. Applicant respectfully submits that each of dependent claims 18-19 depends from and limits independent claim 10 in a patentable sense. Withdrawal of the rejection of dependent claims 18-19 is thus respectfully requested.

Claims 20-28, 30-36, 38, 41-44, 46, 49, and 54-57 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Brown in view of Cleary and in further view of U.S. Patent No. 4,200,152 to Foster et al. ("Foster"). Independent claim 54 and dependent claims 44 and 55 have been canceled, thus rendering the rejection thereof moot.

⁹ Goodwin, Col. 1, Ln. 16-19.

Independent claim 20 relates to a method of drilling deep wellbores from a wellhead into Precambrian and Hadean Era crystalline rock formations for accessing thermal energy. Applicant respectfully submits that the cited combination of references fails to disclose at least one of the distinguishing features of independent claim 20, namely, imparting multiple stress reversals to create a continuous and incremental increase in high thermal differential surface area and reservoir volume whereby continual removal of heat from the rock formation allows much greater efficiency by removing a greater amount of heat density available per unit volume.

Brown teaches the use of hydraulic fracturing to create a reservoir. In contrast to independent claim 20, Brown teaches that the reservoir is inflated to "store mechanical energy through *elastic* compression of the rock comprising the HDR reservoir,"¹⁰ but does not teach imparting multiple stress reversals to create a continuous and incremental increases in high thermal differential surface areas and reservoir volume whereby continual removal of heat from the rock formation allows much greater efficiency by removing a greater amount of heat density available per unit volume as claimed in independent claim 20. Applicant respectfully submits that Cleary, which relates to a method of drilling, fails to cure this deficiency of Brown.

Foster relates to a method by which injection and withdrawal wells are brought into fluid communication with one another so that a hot dry rock formation may be used to create a heat transfer fracture complex or "oven." Foster teaches that ovens of varying sizes may be created through a series of hydraulic fractures. The oven may be used to heat water which may then be used for electrical production. Applicant respectfully submits that Foster fails to teach imparting multiple stress reversals to create a continuous and incremental increases in high thermal differential surface areas and reservoir volume whereby continual removal of heat from the rock formation allows much greater efficiency by removing a greater amount of heat density available per unit volume as claimed in independent claim 20. Withdrawal of the rejection of claim 20 under 35 U.S.C. § 103(a) as unpatentable over Brown in view of Cleary and in further view of Foster is respectfully requested.

¹⁰ Brown, Col. 5, Ln. 55-57, emphasis added.

Dependent claims 21-26 and 28 depend from and further limit independent claim 20 in a patentable sense. Applicant respectfully submits that, at least for the reasons set forth above with respect to independent claim 20, dependent claims 21-26 and 28 distinguish over the combination of Brown, Cleary, and Foster and are in condition for allowance. Withdrawal of the rejection of dependent claims 21-26 and 28 is respectfully requested.

Independent claim 30 relates to a method of developing a high temperature hot dry rock geothermal reservoir for accessing geothermal heat energy therein and production therefrom. Applicant respectfully submits that the cited combination of references fails to disclose at least one of the distinguishing features of independent claim 30, namely, alternating hydraulic expansion and contraction of a fracture cloud to generate coincidental thermal and mechanical cycling of hot dry rock formations and periodic brecciation within the hot dry rock formation, whereby the periodic brecciation serves the purpose of incrementally exposing new high thermal differential surface areas on an incremental basis that will serve the purpose of maintaining high temperature production in the hot dry rock formation.

Brown teaches the use of hydraulic fracturing to create a reservoir. In contrast to independent claim 30, Brown teaches that the reservoir is inflated to "store mechanical energy through *elastic* compression of the rock comprising the HDR reservoir,"¹¹ but does not teach alternating hydraulic expansion and contraction of a fracture cloud to generate coincidental thermal and mechanical cycling of hot dry rock formations and periodic becciation within the hot dry rock formation, whereby the periodic brecciation serves the purpose of incrementally exposing new high thermal differential surface areas on an incremental basis that will serve the purpose of maintaining high temperature production in the hot dry rock formation as claimed in independent claim 30. Brown does not teach that the reservoir cycled to induce brecciation of the reservoir. Applicant respectfully submits that Cleary, which relates to a method of drilling, fails to cure this deficiency of Brown.

¹¹ Brown, Col. 5, Ln. 55-57, emphasis added.

Foster relates to a method by which injection and withdrawal wells are brought into fluid communication with one another so that a hot dry rock formation may be used to create a heat transfer fracture complex or "oven." Foster teaches that ovens of varying sizes may be created through a series of hydraulic fractures. The oven may be used to heat water which may then be used for electrical production. Applicant respectfully submits that Foster fails to teach alternating hydraulic expansion and contraction of a fracture cloud to generate coincidental thermal and mechanical cycling of hot dry rock formations and periodic brecciation within the hot dry rock formation, whereby the periodic brecciation serves the purpose of incrementally exposing new high thermal differential surface areas on an incremental basis that will serve the purpose of maintaining high temperature production in the hot dry rock formation as claimed in independent claim 30. Withdrawal of the rejection of claim 30 under 35 U.S.C. § 103(a) as unpatentable over Brown in view of Cleary and in further view of Foster is respectfully requested.

Dependent claims 31-36 and 38 depend from and further limit independent claim 30 in a patentable sense. Applicant respectfully submits that, at least for the reasons set forth above with respect to independent claim 30, dependent claims 31-36 and 38 distinguish over the combination of Brown, Cleary, and Foster and are in condition for allowance. Withdrawal of the rejection of dependent claims 31-36 and 38 is respectfully requested.

Independent claim 41 relates to a method developing geothermal reservoirs in hot dry rock formations. Applicant has amended independent claim 41 to include the limitation of dependent claim 45. Dependent claim 45 has been indicated as allowable. Applicant respectfully submits that independent claim 41, as now amended, is now in condition for allowance. Withdrawal of the rejection to independent claim 41 is respectfully requested.

Dependent claims 42-43, 46, and 49 depend from and further limit independent claim 41 in a patentable sense. Applicant respectfully submits that, at least for the reasons set forth above with respect to independent claim 41, dependent claims 42-43, 46, and 49 distinguish over the

combination of Brown, Cleary, and Foster and are in condition for allowance. Withdrawal of the rejection of dependent claims 42-43, 46, and 49 is respectfully requested.

Independent claim 56 relates to a method of developing a high temperature hot dry rock geothermal reservoir for accessing geothermal heat energy therein and production therefrom. Applicant respectfully submits that the cited combination of references fails to disclose at least one of the distinguishing features of independent claim 56, namely, alternating the hydraulic expansion and contraction of the fracture cloud to generate coincidental thermal and mechanical cycling of hot dry rock formations and periodic brecciation within the hot dry rock formation, whereby the periodic brecciation serves the purpose of incrementally exposing new high thermal differential surfaces on an incremental basis that will serve the purpose of maintaining high temperature production in the hot dry rock formation. Applicant respectfully submits that independent claim 56 patently distinguishes over the cited combination for similar reasons to those discussed above with respect to independent claim 30. Applicant respectfully requests that the rejection of independent claim 56 under 35 U.S.C. § 103(a) as unpatentable over Brown in view of Cleary and in further view of Foster be withdrawn.

Claims 22-24, 33-35, and 55 stand rejected under the 35 U.S.C. § 103(a) as being unpatentable over Brown in view of Cleary and in further view of Foster. Specifically, Cleary has been identified as teaching the features of claims 22-24 and 33-35. Applicant respectfully submits that Cleary fails to address the deficiencies of Brown and Foster noted above with respect to independent claims 20 and 30, from which claims 22-24 and 33-35 depend, respectively. Withdrawal of the rejection to claims 22-24 and 33-35 is respectfully requested.

In view of the above amendment, Applicant respectfully submits that the present application is in condition for allowance. A notice to that effect is respectfully requested.

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Respectfully submitted,

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